

Work Plan

Evaluation of the Use of Apatite/Phosphate Treatment Technologies

Introduction

EPA's October 12, 2012 letter indicated that the National Remedy Review Board recommended that more detailed evaluations of potential treatment technologies be conducted as part of a Supplement to the Supplemental Feasibility Study [SFS] (EMSI, 2011). Consequently, EPA has asked the Respondents to evaluate the potential application of apatite and/or phosphate solutions for possible treatment of waste materials and/or groundwater. EPA requested that this evaluation be performed at a level of detail comparable to that used to evaluate the treatment technologies previously analyzed in the SFS.

Approach

Typically, the first step in the identification of potentially applicable remedial technologies is to evaluate general response actions that, based on site conditions and media of concern, could address the remedial action objectives (RAOs) at a site. The RAOs developed for OU-1 did not include direct treatment of the waste materials or treatment of groundwater. Consequently, potential remedial technologies related to these response actions were not evaluated in the FS (EMSI, 2006) or the SFS (EMSI, 2011). For purposes of conducting an evaluation of potential apatite/phosphate-based treatment technologies, this initial step, evaluation of general response actions based on site conditions and media of concern, will be skipped. Instead, to comply with EPA's direction, the evaluation will be based on a hypothetical scenario where treatment of the waste/source materials and/or treatment of groundwater have been deemed appropriate response actions relative to the site conditions and media of concern. In the event that apatite/phosphate-based treatment technology is determined to potentially be applicable to OU-1, it may be necessary to revisit the evaluation of general response actions and the identification of other potentially applicable remedial technologies.

Evaluation of the potential applicability of apatite or other phosphate-based treatment technologies for direct treatment of waste/source materials or for treatment of impacted groundwater will be performed using the same approach used to evaluate other potential remedial technologies under a Feasibility Study level-of-effort. The first step will be to identify potential apatite/phosphate-based treatment technologies and perform an initial screening of the technical implementability of such technologies relative to the waste and site conditions. The anticipated approach to the evaluation of potential application of apatite/phosphate-based treatment technology will be based on the following:

1. Review of available published literature; and
2. Discussions with DOE individuals with knowledge of the use and applicability of apatite injection technology.



Subject to results of the initial evaluations, possible applications of apatite/phosphate-based technologies to West Lake Landfill OU-1 may include the following.

1. Injection into waste materials to reduce leaching of radionuclides; and/or
2. Use for treatment of radionuclide occurrences in groundwater.

If the initial evaluations of potential apatite/phosphate-based treatment technologies indicate that such technologies may potentially be applicable to the site and waste conditions in OU-1, these technologies will be subjected to further evaluations, including potential effectiveness, implementability, and cost, in accordance with the procedures prescribed in EPA's "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA" (EPA, 1988).

Results of Preliminary Evaluations

This section provides a summary of the results of initial evaluations completed prior to and during development of this Work Plan. An initial search of technical literature (see References section below) and initial discussions with DOE personnel familiar with the use of apatite-based technologies indicate the following relative to possible use of apatite/phosphate-based treatment technologies:

1. Injection of apatite solution has been successful in halting migration of strontium-90 in groundwater at Hanford;
2. Bench-scale testing at Oak Ridge has indicated that apatite may be effective in treating uranium and heavy metals in groundwater (this reportedly was to be followed up by a pilot-scale test but reports of the results of the pilot-scale testing, if performed, have not yet been located);
3. No reports or information have yet been identified relative to the use of apatite to treat waste/source materials or relative to possible source treatment within a solid waste matrix; and
4. DOE representatives indicated that because of the potential disruption in chemical equilibrium within the waste matrix, such an application could result in an increase in the leaching potential of radionuclides instead of the reduction which would be intended by such an application (Thompson and Wellman, 2012)

Based on the lack of prior use of this technology for source stabilization, and in particular the complete lack of application to a source material composed of municipal solid waste, significant uncertainty exists about the potential applicability, effectiveness and possible unintended consequences of using an apatite/phosphate-based treatment technology to attempt to reduce potential leaching of radionuclides from OU-1.

All published information identified to date relates to the treatment of select radionuclides and heavy metals in groundwater. Specifically, the only published information located so far about treatment of groundwater relates to the treatment of strontium, uranium and heavy metals. No information exists regarding the potential use of apatite or other phosphate-based treatments or radium or thorium in either waste/source materials or groundwater. A study of radium leaching from phosphate deposits in Florida indicated that although such deposits may reduce the solubility of radium, radium was still found to leachate from crystalline phosphate deposits over a relatively short period of time (Burnett, et al., 1988).

EPA previously determined that there is no unacceptable risk of groundwater contamination at the West Lake Landfill site. Specifically, the ROD contains the following conclusions:

1. *These (groundwater sampling) results are not indicative of on-site contaminant plumes, radial migration, or other forms of contiguous groundwater contamination that might be attributable to the landfill units being investigated. (ROD at p. 20)*
2. *The groundwater results show no evidence of significant leaching and migration of radionuclides from Areas 1 and 2. (ROD at p. 21)*
3. *Significant leaching and migration of radionuclides to perched water or groundwater have not occurred despite landfilled waste materials having been exposed to worst-case leaching conditions from surface water infiltration over a period of decades. (ROD at p. 21)*
4. *The lack of radionuclide contamination in groundwater at the Site is consistent with the relatively low solubility of most radionuclides in water and their affinity to adsorb onto the soil matrix. (ROD at p. 21)*
5. *This pathway for migration (groundwater flow to the river) is not considered significant under current conditions because the on-site impact to groundwater from the landfill units is so limited. (ROD at p. 21)*
6. *The fourth (remedial action) objective (collect and treat contaminated groundwater and leachate to contain any contaminant plume and prevent further migration from the source area) is not applicable because a plume of contaminated groundwater beneath or downgradient of the disposal areas has not been identified. (ROD at p. 30)*

Consequently, groundwater was not determined to be a media of concern (i.e., no plume of groundwater contamination exists), and treatment of groundwater was not identified as a potential response action for the site in the prior FS or SFS. Accordingly, groundwater treatment technologies were not evaluated in either the FS or SFS. Additional comprehensive groundwater sampling from all site wells (both OU-1, OU-2, and groundwater detection monitoring wells associated with the former permitted solid waste landfill) was performed in 2012 and 2013 to refresh data regarding the current

quality of groundwater at the site. The results of this monitoring will be reviewed to evaluate whether groundwater contamination originating from OU-1 has occurred and to verify the ROD determinations. The results of these additional groundwater monitoring activities will also be considered during the evaluation of possible apatite/phosphate-based treatment technologies and as appropriate for any other additional SFS evaluations requested by EPA.

Deliverables

1. Interim Deliverable – A brief memorandum will be prepared summarizing the results of the evaluation of potential applicability of apatite/phosphate-based treatment technologies to the waste materials and site conditions associated with OU-1. This interim deliverable will also include a recommendation relative to identification and evaluation of potential additional remedial alternatives that may be based on apatite/phosphate-based treatment technologies.
2. SFS revisions – Assuming that the evaluation of apatite/phosphate-based treatment technologies only entails evaluation of the potential applicability of this technology and does not result in development of new/additional remedial alternatives, the following revisions to the SFS report are anticipated:
 - a. Section 4 – Technology Screening to include evaluation of an apatite/phosphate-based treatment technology
 - i. Section 4.2 – identify an apatite/phosphate-based treatment technology as an additional technology to be evaluated in the SFS
 1. Note: May need to identify other possible groundwater treatment technologies and expand the SFS to include evaluation of these
 - ii. Section 4.3 – include a description of apatite/phosphate-based injection technology
 - iii. Section 4.4 – either:
 1. Identify an apatite/phosphate-based treatment technology as a technology that was screened out; or
 2. Evaluate the implementability of an apatite/phosphate-based treatment technology for either:
 - a. Chemical stabilization of radionuclides in the waste mass (subject to determining that information exists on possible use of an apatite/phosphate-based technology in this manner); or
 - b. For use as possible contingent action in the event that groundwater contamination occurs in the future.
 - iv. Figure 24 – Add evaluation of the technical implementability of an apatite/phosphate-based treatment technology (ies) to this figure.

- v. Figure 27 – Add evaluation of the anticipated effectiveness, implementability and cost of an apatite/phosphate-based treatment technology (ies).

In the event that an apatite/phosphate-based treatment technology is found to be potentially applicable based on the site and waste conditions, there may be a need to develop one or more additional remedial alternatives for detailed analysis in the Supplemental SFS report. Such an effort is not included with the scope of the evaluation of an apatite/phosphate-based treatment technology addressed by this Work Plan.

Clarifications by EPA Requested

EMSI requests clarification from EPA regarding EPA's expectations relative to potential application of apatite and/or phosphate treatment technologies at the site. To date, review of the technical literature and information from other sites has only resulted in identification of application of apatite/phosphate technology for treatment of groundwater. EMSI has not identified any technical literature discussing potential application of apatite and/or phosphate solutions as methods of treating waste/source materials. Therefore, EMSI requests any information EPA can provide regarding known or potential applications of such technologies for direct treatment of waste.

EMSI wants to discuss with EPA the possible role of apatite/phosphate-based or other groundwater treatment technologies relative to preparation of a Supplemental SFS report. These include the following

1. How the SFS should address the lack of/minimal nature of impacts to groundwater relative to any evaluation of a potential apatite/phosphate-based treatment technology for groundwater given that:
 - a. Groundwater was not identified as a media of concern in the FS or SFS and therefore general response actions and remedial technologies for groundwater were not identified or evaluated in either document.
 - b. Groundwater treatment was not identified as being necessary (see above language from the ROD).
2. Evaluation of apatite/phosphate-based treatment as a possible contingent technology:
 - a. Apatite/phosphate-based treatment technology could be evaluated as a technology for possible use as a contingent action in the event that significant groundwater impacts arise in the future.
 - b. Would there be a need to evaluate other possible technologies that could possibly be used as contingent technologies in the event of future groundwater impacts?
3. Evaluation of apatite/phosphate-based treatment (or other contingent groundwater technologies) would be limited to identification and screening of technologies for possible

-future contingent applications: This would not result in development or evaluation of a remedial alternative(s) for groundwater treatment.

4. Overall evaluation of apatite/phosphate-based treatment of groundwater is inconsistent with CERCLA FS guidance documents. Specifically, as groundwater was not identified as a media of concern, the FS and SFS did not identify, screen or evaluate technologies for groundwater treatment.
5. Obtain additional information that EPA may be aware of on prior applications and experience with apatite/phosphate-based treatment technology.

Schedule

It is anticipated that collecting available information on potential use of apatite/phosphate-based treatment technologies, screening of the potential implementability of such technologies to the waste materials and site conditions at OU-1, evaluating the potential effectiveness, implementability, and cost of such potential applications, if appropriate, and preparing a summary memorandum will take approximately six weeks after receipt of EPA clarifications to the items identified above.

Preparation of a Supplemental SFS report that includes the results of the evaluations of apatite/phosphate-based treatment technologies will be performed after EPA's comments on the interim deliverable are received and in conjunction with a comprehensive revision to the existing SFS report required to address the results of the various other additional tasks EPA has requested.

References

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